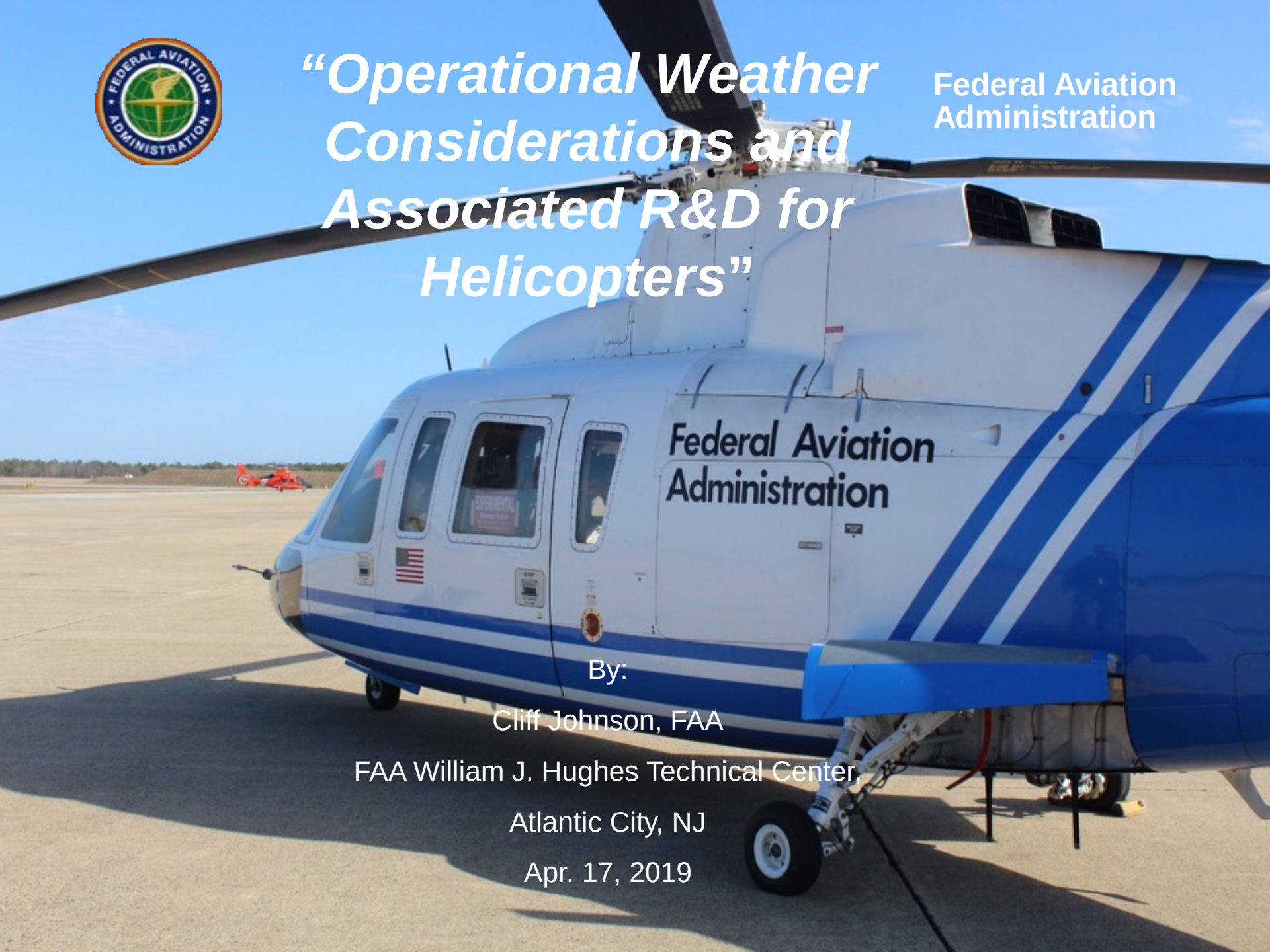

"Operational Weather Considerations and Associated R&D for Helicopters"

Federal Aviation Administration

By:

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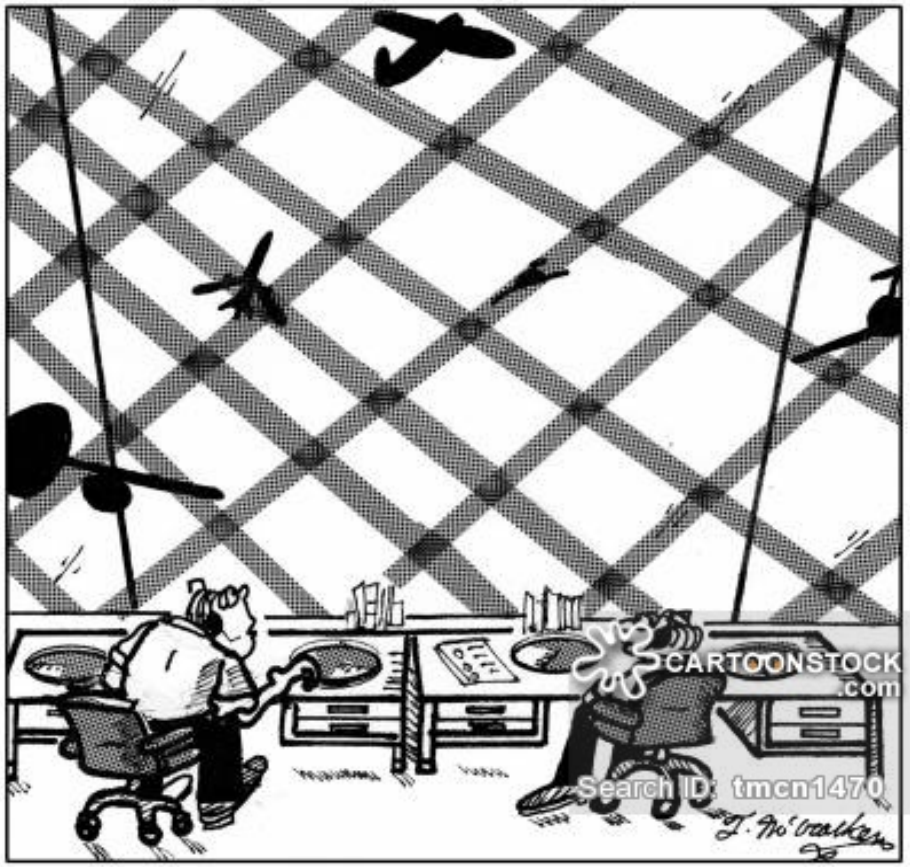
FAA William J. Hughes Technical Center,

Atlantic City, NJ

Apr. 17, 2019

Aviation Weather – Why Does it Matter?



"I thought patchy,
not striped fog was predicted for today."

NTSB Accidents (Weather Related…A Sampling)

- **ERA17FA190**
  - 5/25/2017
  - New Castle, DE
  - EC135
  - 1 Fatality
  - Day IMC
  - Single Pilot IFR Training/Proficiency Flight
  - **Low Visibility**
- **WPR10FA055**
  - 11/14/2009
  - Doyle, CA
  - AS350BA
  - 3 Fatalities
  - Low Illumination Night
  - Unusual Attitude
  - **Spatial Disorientation**
- **CEN13FA096**
  - 12/10/2012
  - Compton, IL
  - BK117-A3
  - 3 Fatalities
  - **Unintended Instrument Meteorological Conditions (UIMC)**

Operational Barriers to Helicopter Pilots – Weather

- **Nearby Aviation Weather Station**
  - (ASOS, AWOS, etc. often 30+nm away)
- **Minimal Infrastructure**
  - Windsock, Lights, sometimes not even that
- **Visibility (Inflight and Destination Location)**
  - No objective means of determining the values
- **Cloud Coverage**
- **Pilots Aren’t Meteorologists**
  - Most don’t qualify…

Potential Operational Solutions

- **Nearby Aviation Weather Station –**
  - Better Coverage Models and Low-Cost Sensors
- **Minimal Infrastructure**
  - Integration of Onboard Weather Reporting Systems
- **Visibility/Clouds**
  - Vision Systems Technology and sensors to better see through Clouds/Low-Vis or ID them
- **Pilots Aren’t Meteorologists**
  - HEMS Weather Tool – Smartphone App

Active Research Areas

- **Helicopter Flight Data Monitoring**
  - Proximity to Weather Safety Metric
  - Instrument Panel Transcription
  - Helicopter Attitude Indication
- **Enhanced Helicopter Vision Systems –**
  - Onboard EVS/EO Sensors/Cameras
  - Remote Weather Cameras Integrated into Cockpit

FAA R&D Test Flight Platform (N38)

- **Test Platform**
  - FAA's Sikorsky S-76A Helicopter, Equipped with ADS-B Out (1090ES)
- **HFDM / HFDR Devices**
  - Appareo Vision 1000, L3 Light Data Recorder, Honeywell Skyconnect Tracker 3, Skytrac ISAT-200A, Stratus, Foreflight, EIT FODR, PWC EDC, HADRAS, Outerlink IRIS, Latitude iONode, HEIM Data Recorder, others…
- **Recording Cameras**
  - 12 POE cameras
- **Attitude & Heading Reference System/Inertial Navigation Unit**
  - AHRS/IRU: LCR-100N, iLevil
- **Advanced Vision System Devices**
  - Displays: Thales Topmax, Elbit SkyLens/SkyVis, SA-62/S OLED HGU-56, Saab AviGuide (Planned), Macroblue MB037W, Universal MFD-640
  - EVS Sensors: MaxVis 1500/2300, Elbit HeliEVS, Hensoldt SferiSense 500 LIDAR, CMC 2700/2900, RTA-4112 (Planned), SNC Multi-Sensor RW DVE (Planned), others…

FAA S76D Simulator

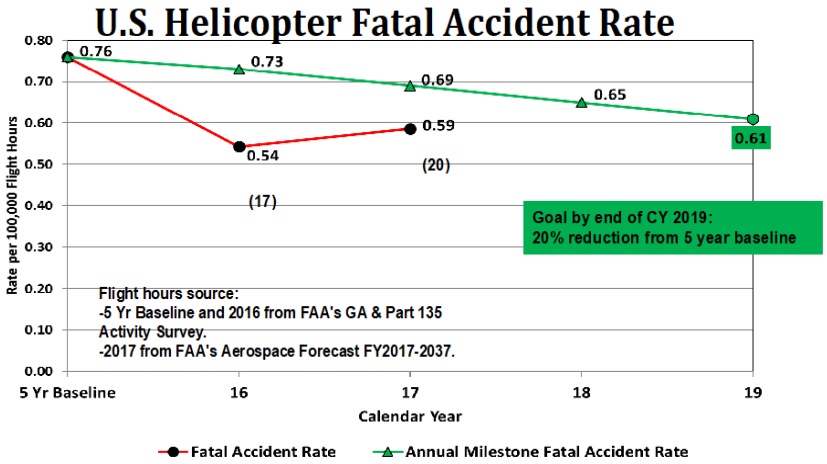
- **Integrated with FAA's WJHTC Simulation Labs**
- **Paired with Aviation Weather Apps (i.e. Foreflight, Garmin Pilot, etc.)**
- **Tailorable for various Weather Scenarios**
  - *Initially used for low-visibility offshore trials for Vision Systems Research*

Helicopter Flight Data Monitoring

- **Motivation**: Reduce the Helicopter Fatal Accident Rate by 20% by 2020

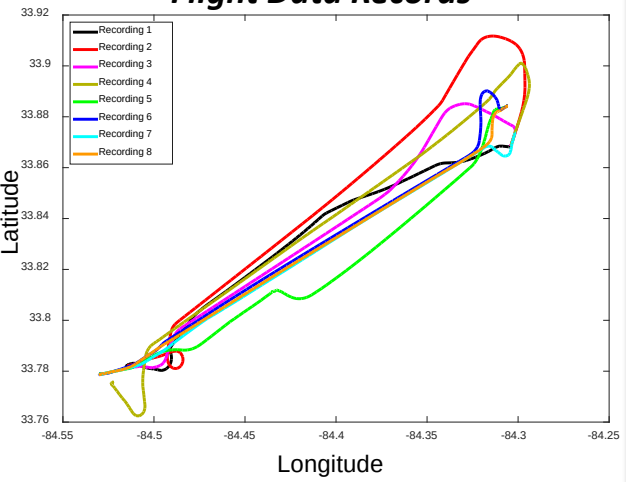
- **Objective**: Develop ASIAS Capabilities for Proactive Safety Risk Analysis using Helicopter Flight Data Monitoring (HFDM)

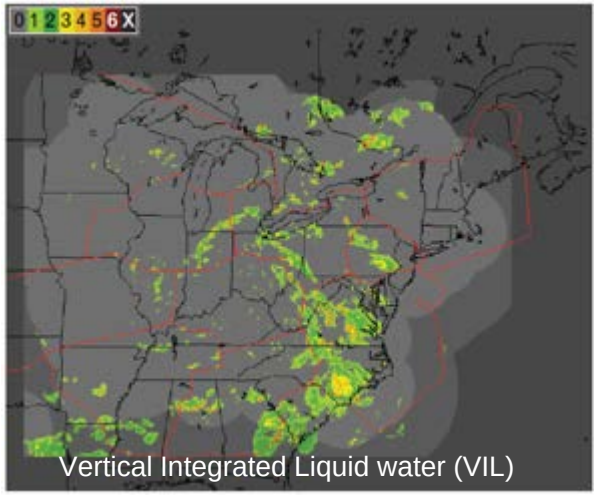
USHST United States Helicopter Safety Team
Our Vision: A Civil Helicopter Community With Zero Accidents



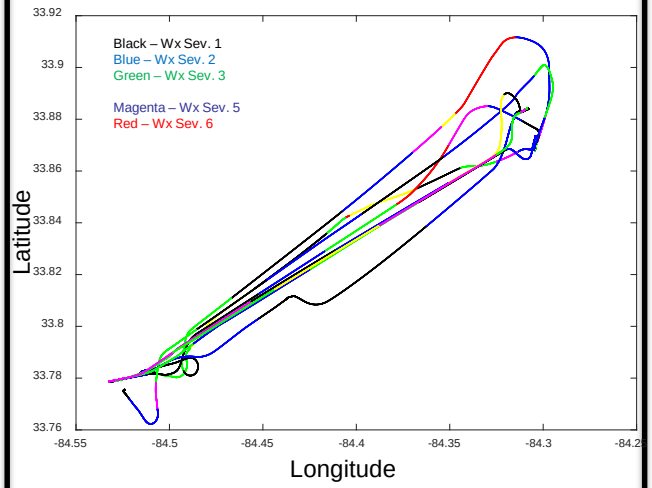
Proximity to Weather Safety Metric

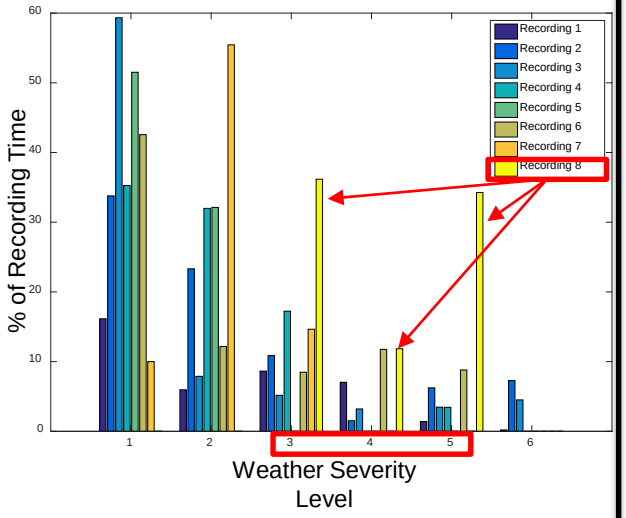
CIWS Weather Severity Levels + Flight Data Records



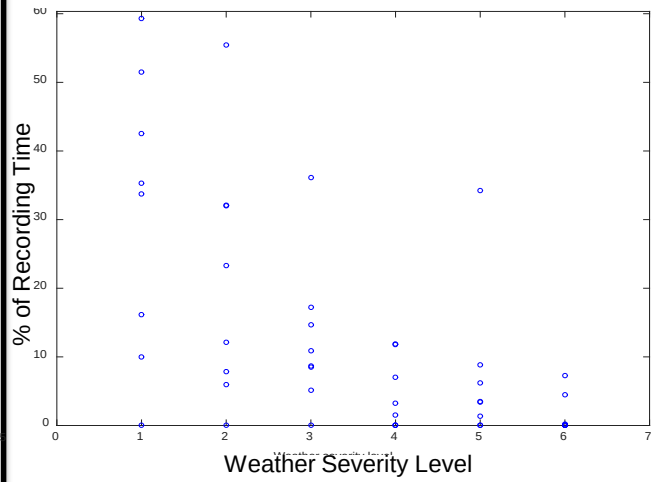


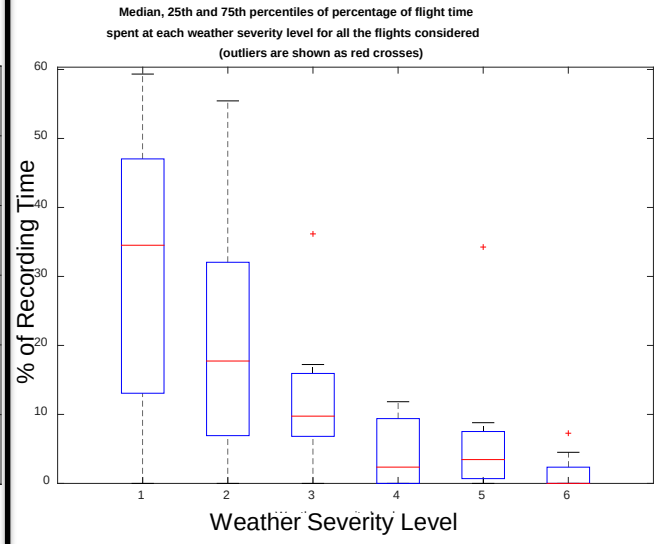
Less than ~10 flights



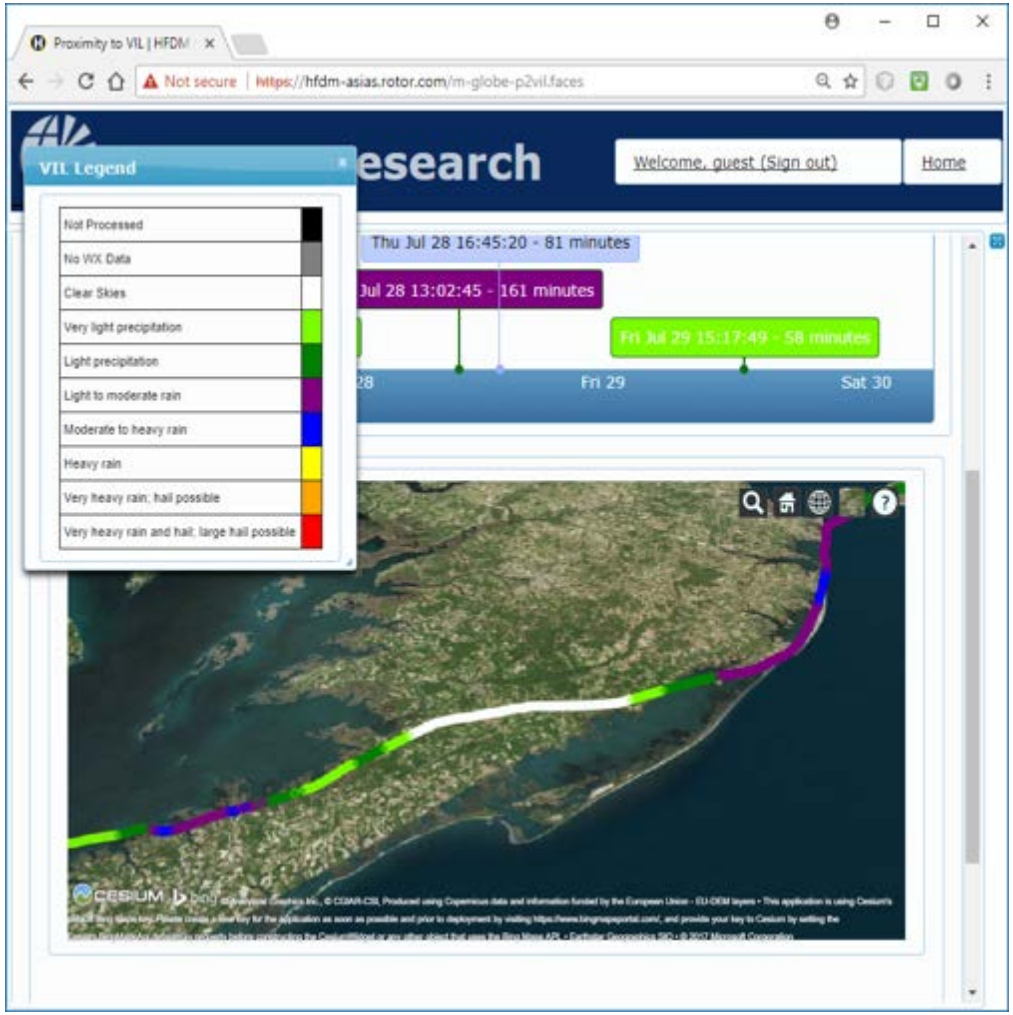


More than ~10 flights





Proximity to Weather Safety Metric

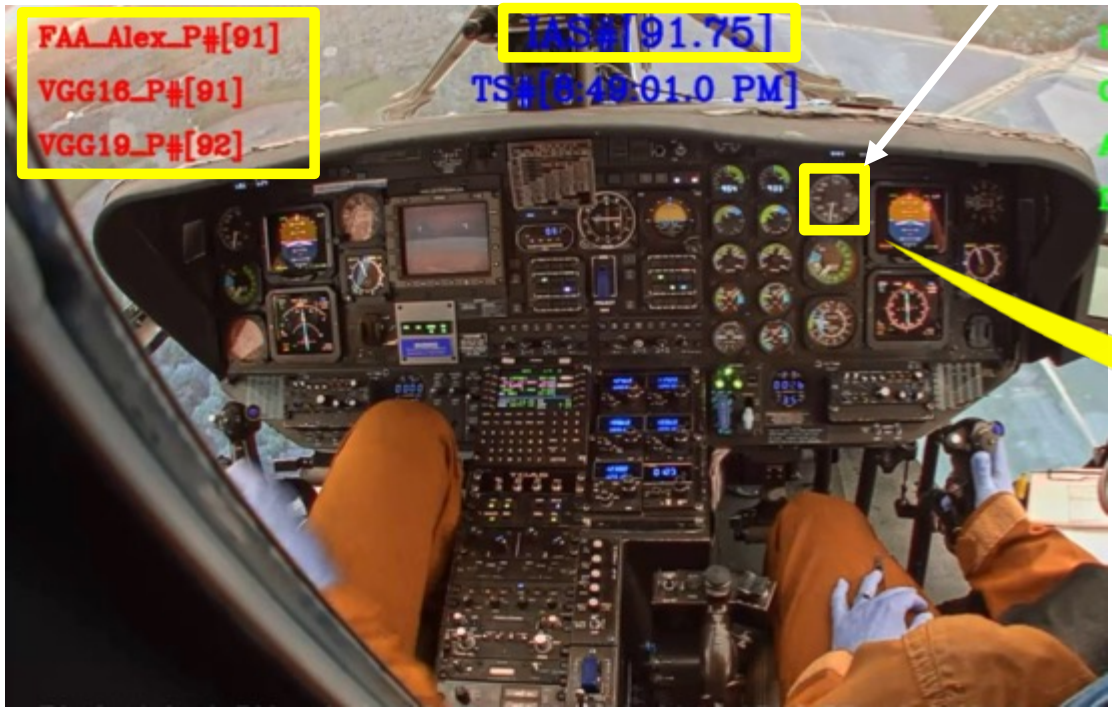


HFDM Video Instrument Gauge Panel Transcription

Estimated gauge measurement using three different deep neural networks

Actual gauge measurement from the flight data recorder

Actual gauge

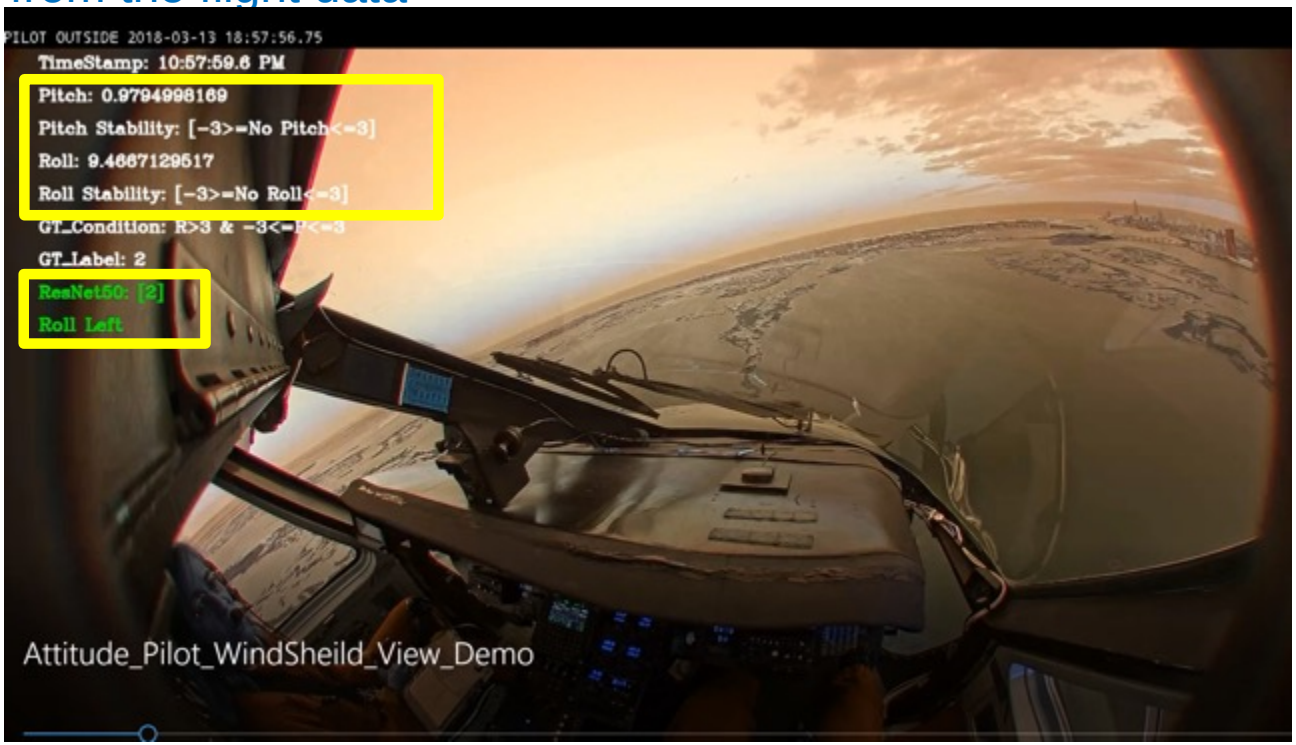


Actual gauge zoomed

HFDM Helicopter Attitude/State Determination

Actual attitude data from the flight data

Estimated attitude using ResNet50



HEMS WX Tool Smartphone App

+

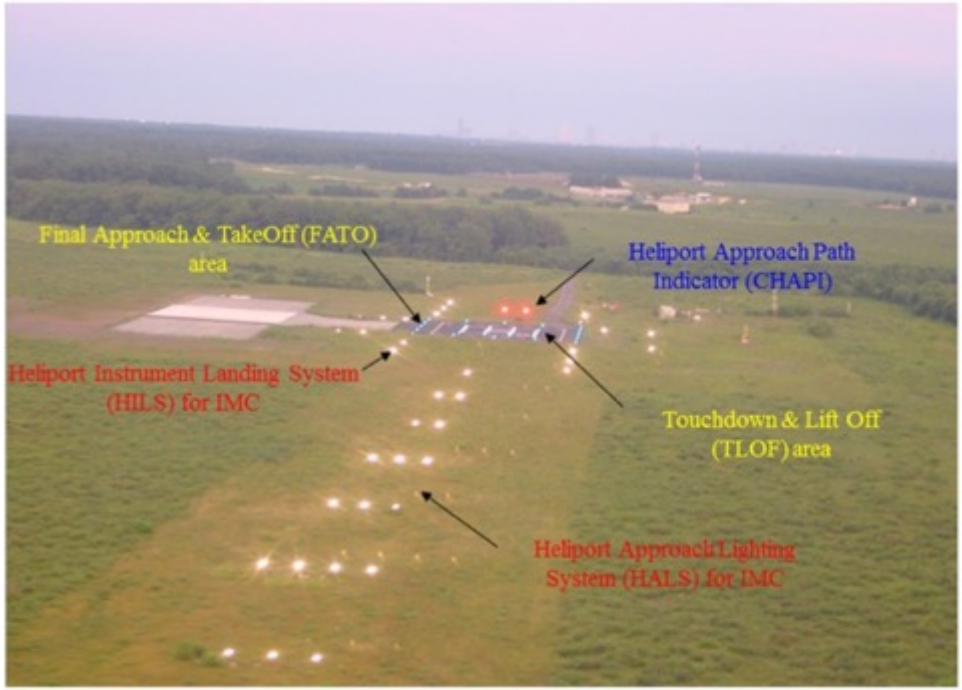
Enhanced Helicopter Vision Systems

- **Motivation**: Improve the Safety of Low-Visibility Operations for Helicopters

Note: ***> 25%*** *of the overall* ***total #*** *of total U.S.* ***helicopter fatal accidents*** *(5-year period of study) resulted from Low/Poor Visibility, Unintended Flight Into Instrument Meteorological Conditions, and Spatial Disorientation*

- **Objective**: Develop Regulatory/Policy Guidance Materials for Operational Approval and Aircraft Certification of Enhanced Helicopter Vision Systems (EHVS) Devices & Concept of Operations

FAA Experimental Helipad (HPM77)



Helipad Outfitted with Various Weather Sensors/Lights:

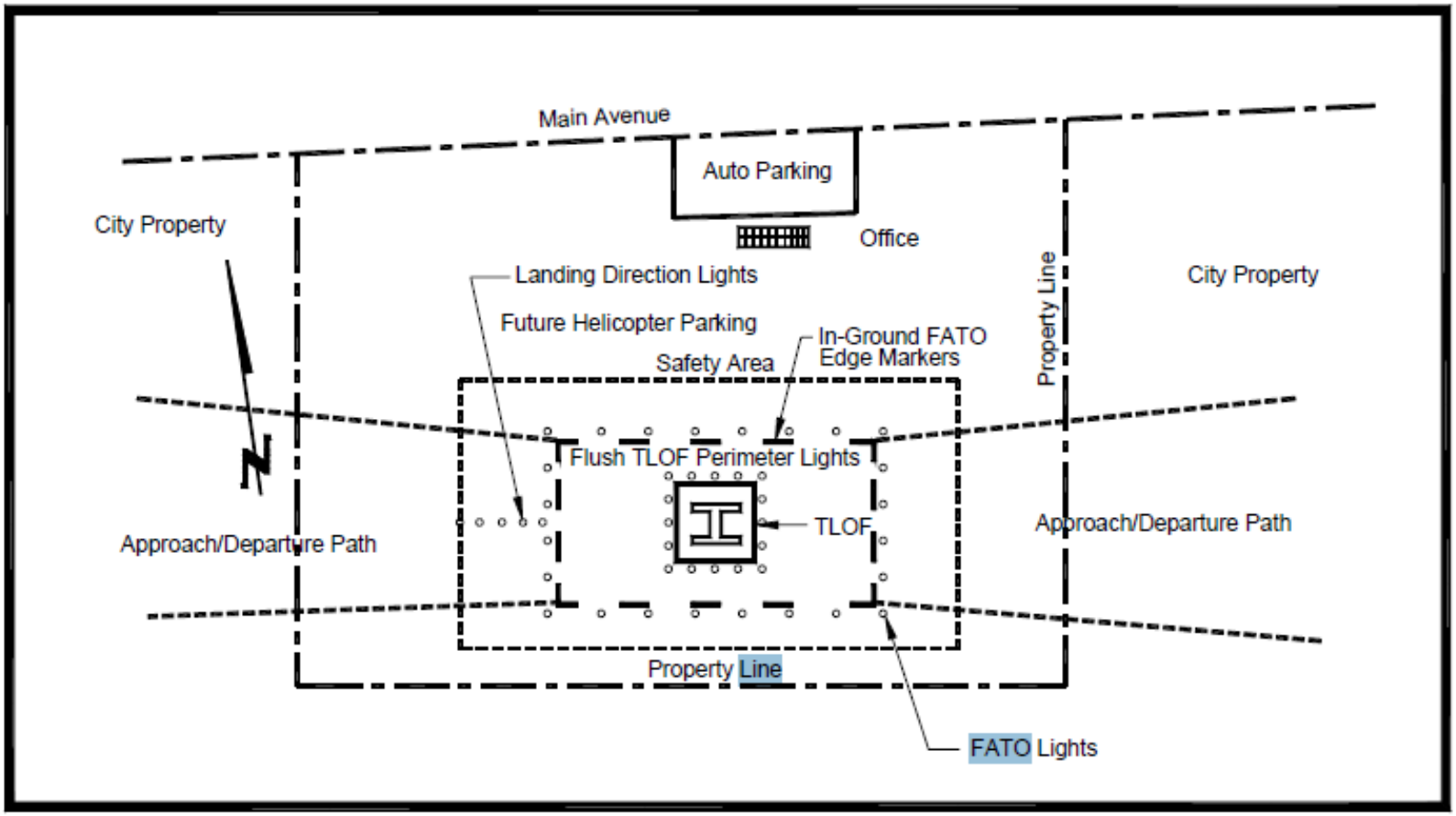
- RVR
- Ceilometer
- Weather Station
- Anemometer (high-fidelity)
- Temperature, Dewpoint, Barometric Pressure (i.e. Altimeter Setting)
- Weather Cameras
- Windsock
- Helipad/Approach Lights (HALS/HILS)

Helipad Visual References (Using FAA Helipad HPM77)

Visual References from AIM & FAA Order 8260.42B

- FATO
- FATO Lights
- TLOF
- TLOF Lights
- HILS
- HALS
- VGSI (CHAPI)
- Windsock
- Windsock Light(s)
- Heliport Beacon (not shown)

Heliport/Helipad Diagram



Note: Layout diagrams should be drawn to scale with key dimensions shown such as TLOF size, FATO size, Safety Area size, distances from safety area perimeter to property edges, etc.

Helipad Weather Cameras

- **Q: Can we put this imagery in the cockpit?**
- **A: We are testing this concept on the FAA Helicopter**

Conclusions/Recommendations

- **Pursue HEMS Weather Tool Smartphone App with new pilot-friendly features**
- **Sensors and Lights can assist pilots in Low Visibility Conditions**
- **Safety metrics can be developed that assist pilots with proximity to weather and other atmospheric phenomena**
- **Weather Technology can help prevent accidents/incidents if used appropriately**

“The most devastating tragedy of an aircraft accident happens if we fail to learn something!”




Questions?